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A Simulation Model of Dynamic Resource Allocation of Different Priorities Packing Lanes: RS Components Warehouse as a Case Study

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Abstract

This on-going MBA work shows what main problems a leading warehouse management faces nowadays and attempts to tackle one of the problems within the packing area. It also suggests ways to improve warehouse productivity that affects construction management performance using simulation technology. Research problem of allocating resources to two different prioritised packing lanes is addressed. A framework for a simulation model is developed to initiate the packing operations for both regular and important lanes which called VIP packing lanes. Case study of one of the warehouses located in Nuneaton, UK is considered. A logical diagram is developed to reflect the workflow in the packing area. A future work “As-Is” and “What-If” scenarios will be developed to manifest problem areas and try to fully utilize the resources between different packing lanes.

Keywords: Warehouse; simulation; packing; resource; allocation

1. Introduction

In warehouses, where materials are stored, repacked, staged, sorted (Bozarth, 2007) and prepared to be delivered to customers, managers seek not only for effectiveness, but for efficiency too. “Warehouse management is the art of operating a warehouse and distribution system or, better still, of operating it efficiently. Excellent logistics performance can open up new markets while customers expect speed, quality and minimised costs. Warehouses and material handling systems are the core elements within the goods flow and build the connection between producer and consumer” (Hompel, 2007).

Warehouses capabilities ranges from fully robotics where only few supervisors and technicians are needed to partially robotics operated or no robotics at all. In Climate-Controlled warehouses, different types of products can be stored within it. This type of warehouses is more complex since it requires special conditions to operate such as controlling temperature, humidity or dust free environment for storing (example: computer products). Warehouses that serve as points in the distribution system called Distribution Centres where products are stored in for short time to be quickly shipped out to customer. Such products held in this warehouse in the early morning and get cleared but the end of the day.

Here are a number of problems that warehouse management faces: optimal allocation of multi-skilled workers to offsite construction production system (Albazi and Dawood 2010), Ineffective storing, picking and routing policies (Altarazi and Ammouri, 2010), search and retrieving times through the picking process (Broulias et al., 2009), inefficient shelves replenishment and order picking process (Gagliardi et al., 2012), high cost of inventory, ordering operations and product transportation (Zhou, 2005), inefficient warehouse layout, routing and storage allocation strategy (Merkuryeva, 2006), waiting time for various processes is very long in a warehouse (Liong and Loo, 2009), Forward-reserve allocation problem in a warehouse with unit-load replenishments (Berg et al., 1997), decision making problems over design and control of manual picking processes (Koster et al., 2006). Ineffective overall performance at Lucas-Acton, England due to ineffectiveness of its information system (Gunasekaran, 1999).

It has been noted that few works have been conducted in the area of packing products and its efficiency, and hence this project is initiated.

In this work, packing area in one of the leading warehouses will be looked at in terms of performance and productivity. This paper is organised in research problem as Section 2 shows. Section 3 is about previous and related work. The proposed methodology and proposed framework are presented in Sections 4 and 5 respectively. A brief on future work is explained in Section 6.

2. Research Problem

On construction management timeline, it is required to receive orders of construction materials onsite by schedule and on time. Any delay that might happen in delivering the order from the warehouse, such as inefficient warehouse operations, to the construction site will have its effects on short and long run. Therefore, efficient warehouse management would improve the performance of construction management.

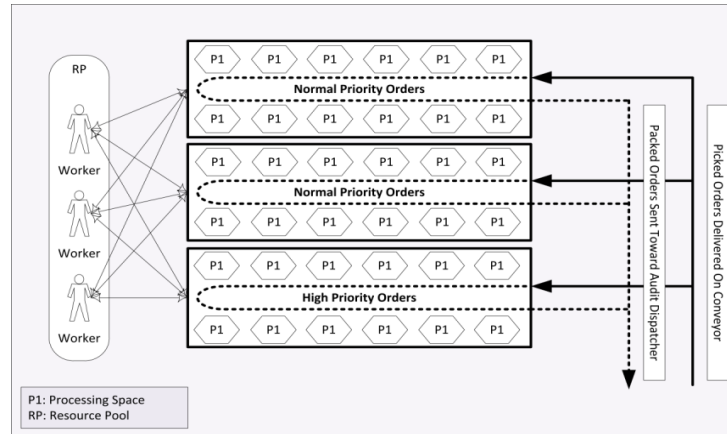
Workers at a warehouse usually work by schedule and most of the time they get allocated from one area to another during the day especially areas that do not require speciality. Managers seek the right balance between number of workers employed and the amount of work to be done in short period of time. Most common problem in this industry is inadequacy of resource utilisation, which eventually gets reflected on low performance and inefficiency.

Based on the nature of products a warehouse is processing, managers divide and sort the products according to their size, weight, type and priority. Once issuing a sales order from the sales department to the warehouse, the system usually directs the order to the right section according to the type of the order and a certain process will put into action to pick, pack and dispatch the order.

This paper focuses on one problem within warehouse management, which is the packing process. Packaging requires human labour which makes it more difficult and costly compared if it was automated. At this stage, workers receive the orders with their priorities so they

know which to be processed and sent to dispatcher first. With proper information system, managers can predict the number of received orders in a certain day. Upon that, resources can be allocated to different lanes in the picking area. On different scenario, workers start processing the prioritised order first whenever they receive it. The workers would interrupt his/her work on low priority orders and start packing the higher priority order. Figure 1 shows a general layout of packing area in a warehouse.

With human error factor, interrupting the packaging process of a low priority orders and put it on hold to process different orders with high priority would create large margin of latency and inefficiency. On different routine, workers can be allocated to the other area when certain amount of pending orders is reached waiting to be packed.



The aim of this ongoing study is to develop a model of dynamic resource allocation to achieve the best utilization in packing area with different packing priority based on discrete event simulation modelling of warehouse operations. The packaging area is the focus of this study as it is considered as one of the main warehousing operations that needs reconsideration and subsequently improvement.

A number of initial targets are set to reflect the steps required to reach the overall target:

- To review of the previous/current practices in the area of resource allocation based warehousing operations.
- To identify the logical operations associated with the packing operation.
- To address the interchanging relations between resources of packing process.
- To model the currents situation to identify bottlenecks/wastages.
- To improve the currents practice of packing operation by proposing dynamic resource allocation plan.

3. Literature Review

Many factors influence the packing performance in the warehouse. For example, the size, type and the nature of the order which might require special type of packaging affects the

speed of packing process. In addition, the priority of which order needs to be processed first affects directly the overall packing process.

Several research projects using simulation technology to improve the performance of warehouse operations have been conducted. Most of the recent researches were conducted on the picking operations and only few on packing area or resource allocation: Patlola P., (2011) developed a statistical model using simulation that helps optimising machine, material-handling equipment and labour performance during pre-picking stage. A warehouse implemented this model resulting in operational and economic performance improvements after four months. Shiau and Lee (2009) developed a hybrid algorithm to generate a picking sequence for combining picking and packing operations using linear programming model. The results of this research were helping the warehouse eliminating storage buffer and reducing picking and packing operation time. Chow et al. (2006) proposed an intelligent system model that incorporates case-based reasoning technique, route optimizing programming model as well as automatic data identification Radio Frequency Identification technology. The outcomes were significant enhancement of logistics service providers in resource planning and execution. Macro and Salmi (2002) developed four warehouse design concepts: Selective Rack Concept, Flow-Through Rack Concept, Pushback Rack Concept and Maximum Rack Concept. This work provided for a warehouse owner varying options of warehouse capacity, complexity and cost strategy. Zhou and Setavorphan, (2005) developed a pattern-based model using simulation model on in-bound, truck-dock and out-bound operations in a distribution centre. The outcomes of this research helped to identify the sub-activities in a warehouse and enhance the performance (RS Components, 2013).

The literatures above provide the researchers a number of ideas regarding the potential tools and techniques that can be used to satisfy objectives and hence the aim. The next section presents the proposed methodology that can be adopted in such work.

4. The Proposed Research Methodology

A number of techniques are expected to deliver the objectives and subsequently the main aim of this study:

- Flowcharts/ Process Mapping of resource allocation for different priorities lanes.
- Activity Cycle Diagram to show the entities, interaction, activities & queues in the system.
- Simulation Technology to mimic the real world problems within the system.
- Heuristic Approach to successively evaluate the problem and find a resolution for it.

5. The Proposed Framework (Future Work)

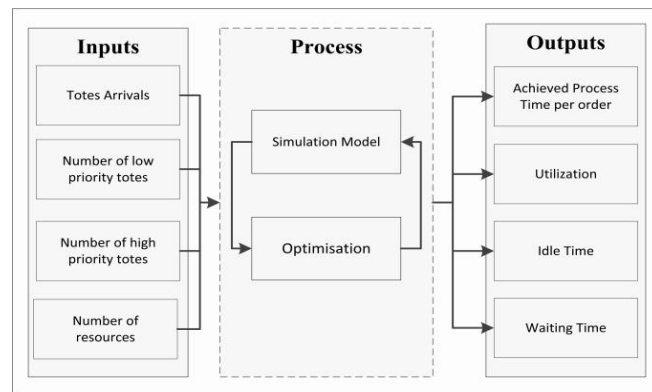
The research framework is proposed in terms of how to enhance the performance of packing area by reallocating resources according to the amount of orders received.

The aim of this framework is to outline the guiding key structural elements on any packing area within a warehouse, including:

- Processes to identify and assess the performance.
- Sub-routines and any temporary processes.
- Mechanisms of allocating resources.

Figure 2 illustrates the proposed framework of the simulation of the packing process. The model expects to receive orders of low and high priority and their inter-arrivals to simulate mathematically the packing process.

Four key performance indicators will be measured during the simulation time: Process Times which it should be at its minimum, Resource Utilisation which it should be maximised, Idle Time and Waiting Time should be both at their minimum levels. The simulation process will try to optimise these values to reach the optimal values, if possible.



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6. Next Phase of this Work

Figure 3 shows an initial simulation model of the problem based on a real life case study. This model will be enhanced on further collected data in the future. Different 'What-if' scenarios will be run for a better resource utilisation based on intelligent & dynamic resource allocation within the packing area.

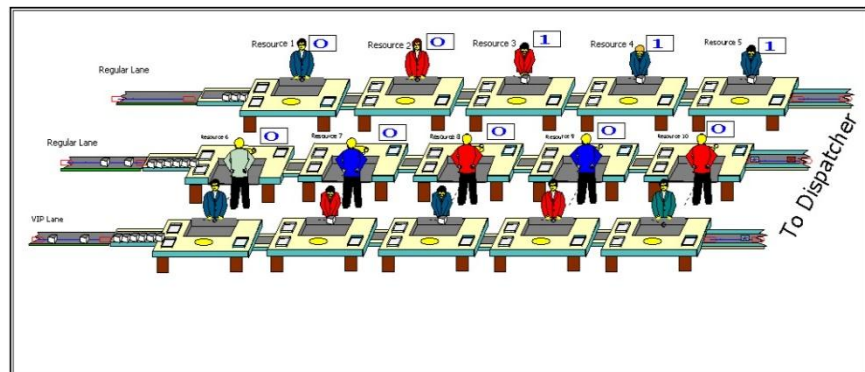


Figure 2 General layout of packing area in a warehouse

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